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II.

PHYSICAL GEOGRAPHY OF THE NORTH-WESTERN BOUNDARY OF THE UNITED STATES.

By George Gibbs. Read November 11, 1869.

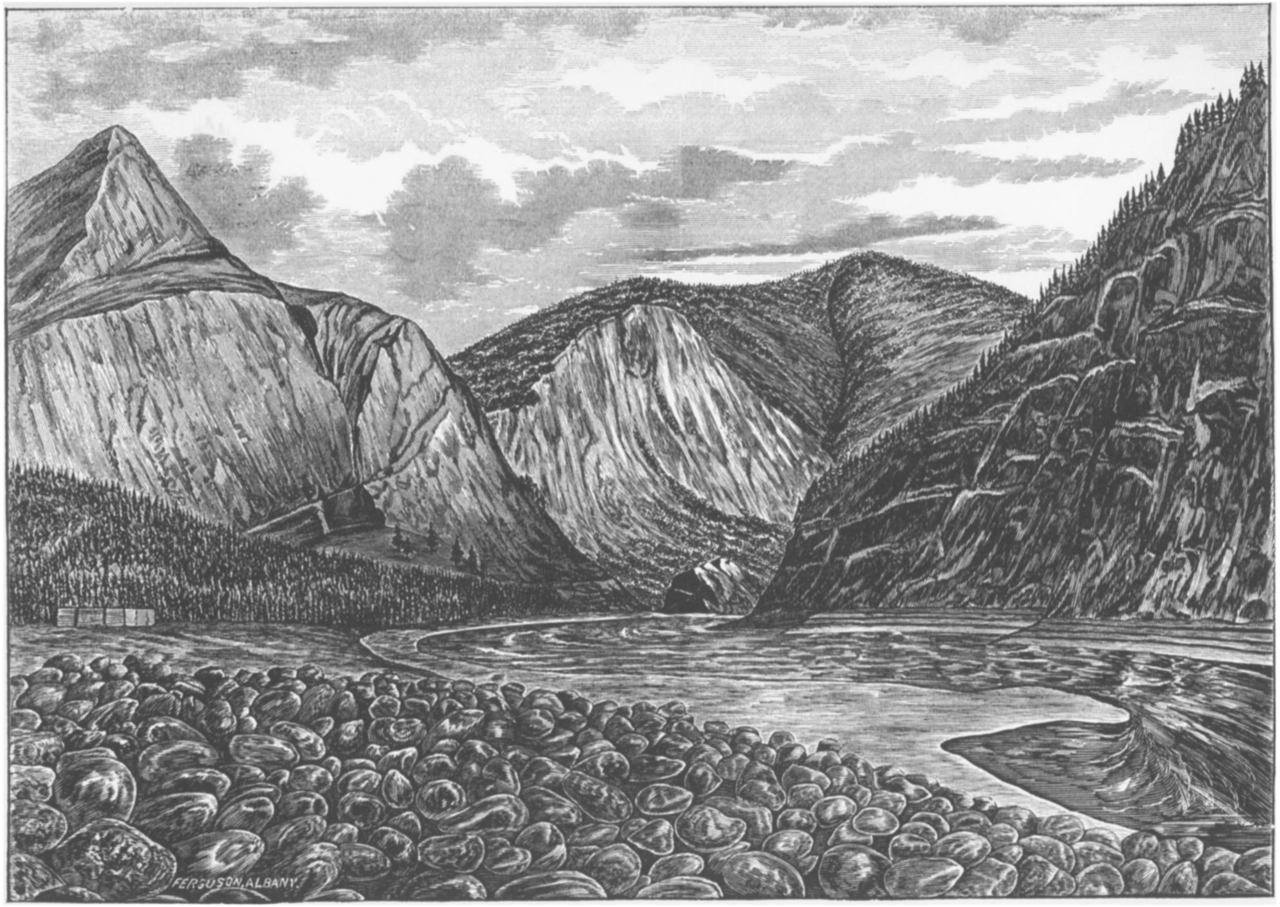
Physical Outlines.

The principal divisions of Oregon, then comprising also what is now Washington Territory, were characterized by Mr. Dana, in his volume upon the Geology of the United States Exploring Expedition, chap. 17, as the Coast, Middle and Interior regions, separated from one another by the Cascade and the Blue Mountains; and the first again subdivided by the Coast range.

As this paper will be chiefly confined to that portion of the country lying north of the forty-sixth parallel, a somewhat different distribution may properly be made. I should distinguish the physical divisions of Washington Territory as the Coast region, subdivided as above; the Columbia basin, including the Yakama valley and the Spokane plateau, or, generally, that portion of the interior lying south of the forty-eighth parallel and west of the Bitter Root range; the region north of this last, which may be called that of the Upper Columbia; and, finally, the basin of the Upper Flathead and Kootenay rivers, lying between the Bitter Root and the Rocky Mountains.

Coast of the Pacific.

The district immediately bordering the sea-shore is, in Oregon and Washington Territory, but a narrow strip, for the most part, of very broken country, resting against the western slope of the Coast range. It is indented by a


FERGUSON, ALBANY.

FRASER RIVER AT FORT YALE.

number of bays, of which the estuary of the Columbia, Shoalwater bay and Gray's harbor are conspicuous. This border is but the remains of a district of whose former extent we have but little comprehension. The whole line of the Pacific exhibits, on a scale of unparalleled grandeur, the power of the ocean in its encroachment upon the land. Everywhere, one sees projecting promontories and rocky islets, pinnacles and columns, at a distance of miles from the shore; surviving witnesses of the force which for ages has thundered against its barriers, has undermined, thrown down, and finally comminuted its materials, and left behind but these isolated memorials of its progress.

But it is only when we contemplate the present shore, over an extent of many degrees of latitude, in connection with the evidences that geology presents of its former configurations, that the mind can compass the reality. From Cape Mendocino, in latitude 40° 30′, to Point Conception in 34° 30′, the coast mountains of California present a succession of parallel ranges, lying, as it were, *en échelon*, or overlapping one another, and including between them longitudinal valleys, such as those of the Rio Salinas of San Francisco Bay, Clear Lake, and of Russian and Eel rivers. Through this distance, the curves and indentations of the shore indicate encroachments to a great though unknown extent; but south of Point Conception the ocean has, in destroying the last landmarks, also left a determinate record of at least one step in its advance. Along the borders of Lower California, the Coast range has itself disappeared, and is now represented only in a group of islands, and, perhaps, one or two salient points of the peninsula, the rest having perished before the tireless assaults of the waves.* So, to the north of Cape Mendocino, the whole Oregon shore, as far as Cape Flattery, has been eroded into one concave sweep;

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* Newberry, 9 vol. Rep. on the Colorado, p. 11.

and all but a single range of a once compound system carried away, from the forty-fourth to the forty-seventh parallel, or between the Umpqua and the Chihalis.

From the Strait of Fuca, northward, still greater changes are visible; though here, other forces have lent their aid to the modification of the shore. The line of the mainland is set back, as it were, to the eastward, more than two degrees of longitude; its trend again becomes more westerly, and instead of presenting an almost continuous line, numberless arms or fiords cut deep into the land. Where its bounds should have been, only a few islands mark its erosion, its subsidence or unequal upheaval.

It might have been supposed that so vast an amount of detritus as must have arisen from this continued erosion would have shoaled the neighboring sea; whereas, the Pacific, unlike the Atlantic ocean, deepens rapidly on leaving its immediate shore. The cause, I presume, to be in the prevalence of sub-marine currents, which have carried off the wash from the land and deposited it at a distance.

In conformity with this view are the statements of many who have navigated the North Pacific, that they have observed indications of soundings, at different points, from fifty to seventy-five miles from the shore; and the actual discovery, by the United States Coast Survey, of a bank, having not more than forty-two fathoms, at a distance of about forty miles off the mouth of the Umpqua.

The prevalent winds of the coast are, during the winter and spring months, from the south or south-east, through which seasons they are almost constant. Storms are most violent and frequent north of Cape Mendocino, and generally close with a heavy but short-lived gale from the south-west, which drives the swell of the Pacific in thunder against its shores. The size and force of the waves may be estimated by the fact that they *break* in thirteen fathoms water.* In the summer and fall, on the other hand, the winds are northerly and north-westerly, and, sweeping down the coast, produce an observable current to the southward, strengthened by the Japanese current, which is to the coast of America what the Gulf Stream is to that of Europe. The coast mountains throughout Oregon, and that portion of Washington Territory south of the Chihalis, are of comparatively insignificant height, but in the peninsula lying between Puget's Sound, the Straits of Fuca and the Pacific, they attain an altitude equal to that of the Cascades. This group, as it properly is, has received the name of the Olympic Mountains, from that bestowed by the voyager Meares upon some prominent peak, which, however, seems to be merely the culminating point of a mass of nearly equal altitude. Mr. Dana assigns to this, Mt. Olympus, a height of 8,000 feet; that of Mt. Constance, visible from Port Townshend, was ascertained by the Coast Survey at 7,777 feet. Snow lies on many of the summits through the year, but not in a continuous cap or covering. They are drained by a number of rapid streams running in immense ravines, and bringing down great quantities of water during their freshets. Very little is known of their interior topography or geology, but they probably resemble the opposite Cascade range. The group evidently at one geological epoch, that of the drift, has formed an island; and a subsidence which would cover the drift of the Puget's Sound country, say, of 300 feet, — would restore it to that condition.

Basins of the Willamette and Puget's Sound.

Between the Coast range and the Cascades is a longitudinal depression, corresponding with the valleys of the Sacramento and San Joaquin, in California. This, in

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*There would seem to be a counter in-shore current, prevalent at least during the continuance of the south winds, as Vancouver mentions his having been set north of his supposed position. (Capt. Patterson, U. S. Coast Survey.)

Oregon, constitutes the valley of the Willamette, and in Washington Territory is continued through from the Columbia, forming the basin of Puget Sound, and finally sinks beneath the sea in the Gulf of Georgia and its northern prolongation. The portion of this valley lying upon the Columbia extends from a little above Fort Vancouver to the mouth of the Cowlitz; the river, turning suddenly northward at the former point, and subsequently resuming its westerly course. It is a strip fifty or sixty miles in length, and nowhere exceeding a few miles in width. The land lies generally in tables, a river level or interval, and a higher terrace behind it. The former is to a great extent overflowed during the freshets. It is of light alluvial soil, comparatively fertile and skirted along the banks with cottonwood. The higher tables are wooded with evergreens. North of the Columbia a subordinate basin is drained by the Chihalis, which cuts through the coast range into the Pacific.

The country bordering on what is usually called Puget's Sound, including under this appellation not merely the Sound proper, but Admiralty Inlet, Hood's Canal, and the various bays which open to the sea through the Straits of Fuca, together with that on a part of the Gulf of Georgia, is a slightly rolling table land, presenting generally steep bluffs to the water, and rising in benches to the height of 200 and 300 feet as it recedes from it. Excepting a few tracts of prairie, it is heavily timbered, the prevalent growth being of coniferous trees. A thick underwood accompanies these forests, which, in size of timber and rapidity of growth, remind one of the tropics. The mildness of the winters and the amount of rain which falls during a protracted season, rather than any unusual fertility of soil, furnishes the explanation.

A glance at the map of this region at once draws attention to the series of inlets referred to, which are remarkable, not merely from their ramification, but from their great depth, their bold shores, and the steep and precipitous bluffs which almost everywhere rise from the water. The usual soundings may be stated at from forty to sixty fathoms; the latter being frequently exceeded, and the former often continued to the immediate vicinity of the bank. In these inlets, the tides are singularly complicated, and their height varies with the locality. While, for instance, at Port Townshend, the mean rise and fall is four to six feet, at Olympia it reaches twenty-two feet.

The rivers emptying into the sound, from the Cascade range, open at their mouth's through narrow alluvial bottoms, bordered by bluffs like those lining the inlets. They are, as might be supposed, rapid and tortuous; subject to heavy and sudden freshets, from excessive winter rains, and they necessarily bring down great quantities of earthy detritus as well as of timber. The accumulations of this last, form rafts at different points, which from time to time are swept out and lodge on the shoals at their mouths, or are stranded along the shores of the sound. Most of the rivers have small deltas, and their deposits are gradually filling up or shoaling the bays into which they empty. Of the numerous waterfalls, the finest is that of the Snoqualmoo, a branch of the Srohomish river, which, emerging from the mountains, makes an unbroken leap of 275 feet, the width of the stream being one hundred. Lakes are scattered abundantly through this country, of which Dwamish lake, near Seattle, and Whatcom lake, having its outlet in Bellingham bay, are the largest. The latter appears to occupy a fissure between the tertiary sandstones and the metamorphic rocks.

Cascade Range.

This chain is a continuation of the Sierra Nevada, though a chasm occurs at the passage of the Klamath; but the two portions occupy the same relative positions to the coast, and to the valleys which intervene between them and the Coast range, and evidently follow the same general fissure. Through the length of Oregon and Washington Territory, the Cascade range runs north and south, parallel to, and at a distance of about 130 miles from, the shore of the Pacific. Near the forty-ninth parallel, it deflects north-westerly, in conformity to the new trend of the coast, and is called, in British Columbia, the Marine range. Its general elevation may be stated at from 5,000 to 6,000 feet, above which the great volcanic peaks tower in isolated grandeur. The chain obtained its name, by no means an appropriate one, from the fact that the cascades of the Columbia occur at the passage of that river through it.

FORESTS.

In a country like the Coast and Cascade region, the density of forests and undergrowth prevents an accurate observation of the details of geology; both because the rocks are generally hidden from view, and travel is impossible, except by rivers or established trails. The luxuriance of the forest, especially when the depth of soil, and the abundance of moisture are favorable to vegetation, is but little affected by latitude to a point far north of the bounds of the survey. Everywhere one finds trees of magnificent size; alder, maple, cottonwood, thuja and spruce, where the ground is subject to occasional overflow, and firs on the higher benches and mountain sides. The yellow fir, *Abies Douglasii*, is the prevalent forest tree of the whole country from the Cascade range westward, exceeding in number all the rest combined. The cedar, or more properly *thuja* (*T. Gigantea*), is next in abundance, attaining its greatest size in the bottoms and other damp situations. Above the zone in which these flourish, the silver and balsam firs replace the forest of the lower country, and are seen rising amidst snows which melt only with the last of summer. Descending eastward, pines and larches succeed, unknown to the Pacific declivity.

The undergrowth is more varied than the forest; vine maples and willows, the dogwood, azalea, crab, salmonberry and elder fill the lower bottoms, and the gualtheria or sallal, ceanothus, bear berry and wood fern, the drier forest country; while on the small prairies and openings are spireas, roses and other shrubs; mosses and lichens, as might be supposed, are abundant in this humid climate. They form a thick carpet on the ground, cushion the limbs of trees, and depend in festoons from the twigs. Of animal life there is but little visible in these woods, and their recesses are silent, except when the wind sweeps through them, or some old trunk falls, with the sound of distant thunder. Vast quantities of dead timber encumber the ground, either fallen by decay, upturned by wind, or hollowed out and undermined by fires. Some of them, mouldering away, add to the soil; while in particular species, the wood is so indestructible that upon the yet solid trunks of fallen giants, trees of formidable size rear themselves, sending down on either side column-like roots. Vast tracts of forest land have been swept by fires, springing perhaps from the smouldering ashes of some Indian hunting camp, or intentionally started to create a growth of berries. In the neighborhood of one of these conflagrations the dull sound of falling timber echoes at night like the discharge of minute guns. No sight can be more desolate than the newly charred woods. As far as the eye can reach successive ranges of hills are covered with blackened trunks, stripped of their foliage and branches, but still erect and tapering like a forest of needles.

The general prevalence of coniferæ, with their dark foliage, gives, especially at a distance, a somber monotony to the scenery of the north Pacific coast. This is, however, in some measure, relieved along the banks of the rivers by the lighter colored masses of the cottonwood and alder; and in the narrow bottoms, by the feathery sprays of the vine maple and dogwood, and the broad flakes of the azalea. The vivid colors of Atlantic forests are here wanting in autumn; still, for the artist, the country presents infinite attractions, not only in the grand features of its scenery, the snow peaks which rear themselves above the Cascades, and the tremendous defiles of the rivers, but in the study of minute details, the many colored stains of lichens on the rocks and trees, and the lights glancing through the forest upon the undergrowth below.

INTERIOR REGION.

Between the Cascade and Rocky Mountains lies the region drained by the Columbia and its branches, divisible as above mentioned, so far as Washington Territory is concerned, into three sections, each having its own characteristics. From the great bend of the Columbia, in latitude forty-eight degrees, southward to Lewis' fork on the Snake river, is a district elevated about 1,000 feet above the level of those streams, and known as the Plateau of the Spokanes and Nez-Perces — Indian tribes in whose country it lies. Connected with it in geographical position, as well as in geological structure, is that lying to the west between the Columbia and the Cascade range, and drained by the Yakama river.

It is only in these that the term "Basin of the Columbia" has any other than a hydrographical sense. Here the whole face of the country has changed. Instead of the forest which envelopes the coast and mountain regions, broad and arid plains covered with artemesias, or hills clothed only with bunch grass, extend in every direction. The surface of the country is scarred with canons; the rivers are walled with basaltic cliffs, and the universal aspect is one of barrenness and desolation.

Some small valleys, principally along the foot of the mountains, alone afford spots suitable for cultivation. Of the rest, however, much is adapted to grazing, and is pastured by droves of cattle and Indian horses. Above the forty-eighth parallel, a series of ranges, having a general direction of north and south, extends from the Cascades to the Rocky Mountains, and this condition applies equally to the adjoining portion of British America.

For reasons presently to be explained, the eastern part o' this region, that lying beyond the Bitter Root Mountains and their northerly continuation, is here regarded as a separate district. The mountains which occupy the section of country so restricted, are, at least in Washington Territory, undistinguished by prominent peaks or striking outlines. They present a pretty uniform height of from 5,000 to 6,000 feet; are timbered, and with a more varied forest than that of the Coast region; the larch and several species of pine mingling with the firs, while the thuja is, for the most part, confined to the gorges of small streams, and is not conspicuous for size. Indeed, except the larch and red pine, *pinus ponderosa*, the timber is smaller than toward the sea coast.

Conforming to the direction of the mountain ranges, the rivers of this district pursue, for the most part, a course singularly direct and parallel; their valleys are little more than troughs, and the land capable of settlement is confined to small and isolated spots. A remarkable feature is the number and length of the fluriatile lakes, of which those on the Okinahane and the Columbia are striking examples.

Glancing at the map of Washington Territory, it will be seen that, at the 114th parallel meridian, a little south of the forty-sixth parallel, the watershed of the Rocky Mountains is suddenly shifted over two degrees of longitude to the east; and that, while its former course is continued in a direction nearly north-west by the Bitter Root range, a longitudinal basin, drained by the sources of Clarke's Fork, the Kootenay and the Columbia, has been gained to the Pacific slope by the division. The geological character and many topographical features of this last district are widely different from that adjoining it on the west, and indicate that the Bitter Root Mountains are the true axis of the system.

Like the other, this section is generally wooded, but its valleys are wider ; it contains some prairies, and, at least in the southern part, it presents, notwithstanding its elevation, far greater attractions for settlement.

CLIMATE.

As might be supposed, in this great region, traversed by mountain chains of such extent and elevation, the varieties of climate are extreme. The vapors of the Pacific, arrested first by the Coast range, descend in light but frequent rains upon the strip which borders the ocean, and the quantity of water that falls during the year reaches sixty inches. Snow is rarely seen, and remains but a day or two at farthest. The prevalent winds of winter, as before stated, are from the south, and, sweeping over so great an expanse of water, come laden with moisture, but of mild and equable temperature. The same fact exists, to a somewhat less extent, in the basins of the Willamette and Puget sound. The southerly winds draw through the river valleys, from November till late in the spring, and moderate the temperature, which the vicinity of so high a mountain range would otherwise render severe. It is rarely that snow falls more than once in a winter, or remains longer than ten days or a fortnight. The duration of cold is generally about the same, and is produced by winds from the north. The ground is never sufficiently frozen to injure grain. The Columbia river is occasionally closed by ice for a few days, between the Cascades and the Willamette, but this originates, in the first place, in drift-ice from above, which becomes compacted and frozen together. During the spring months, rain continues to fall, but, from

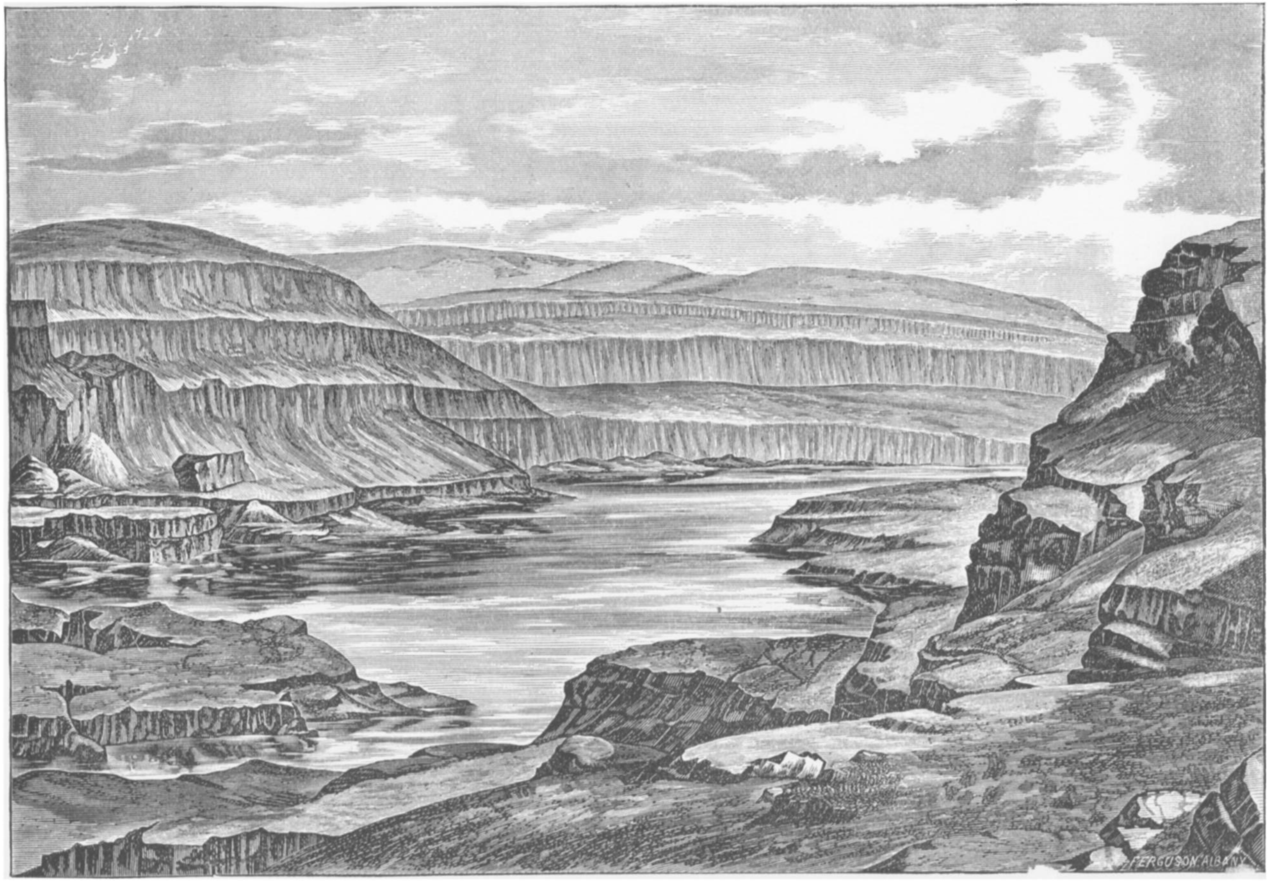
July until the end of October, it is rare. Thunder is seldom heard, and thunder-showers, such as occur on the Atlantic, are unknown. Thunder, in fact, when it does occur, is most common in the winter season. The nights are cool throughout the entire summer.

East of the Cascade range, the climate varies greatly with the locality. As a general thing, the summer is a continuous dry season, and the winters are far colder than in the western section ; snow taking the place of rain, over most of the country. Around Walla Walla, the temperature does not differ, materially, from that of the Willamette, but on the Spokane plain, immediately north of it, the cold is intense and snow lies until late in the spring. Here, as well as on the Yakama, the Indians drive their cattle and horses to some sheltered valley, to winter. In the mountainous country northward, as well as in the eastern basin, the winters are, likewise, severe, and the snows of considerable depth. The summers are warm and without rain, excepting in the district between the Bitter Root and Rocky Mountains, where showers are of more frequent occurrence and are often accompanied by thunder.

EFFECT OF RAINS ON THE RIVERS.

As in intertropical climates, the seasons of this country, more especially its coast section, are divided into wet and dry. The rise of the rivers, necessarily corresponding with the source from which their waters are supplied, those of the coast, is suddenly and violently affected by the winter rains. Where, as in the valleys of the Willamette, the Sacramento and San Joaquin, the drainage from the level surface of the country is inadequate to carry off the floods which pour down from the mountains, vast lakes are formed, and, in unusually wet seasons, the whole bottom becomes submerged. The disasters which have frequently overtaken the town of Sacramento are well known. During the winter of 1862, the basin of the river, from which it takes its name, presented one sheet of water from mountain to mountain. Cattle, horses, buildings, and even men, have been swept away. Similar disasters have, at times, befallen the inhabitants of the Willamette. Even in other streams, where the descent is more rapid, but where the channels are narrow or canoned, the rise of water is extraordinary. The Klamath, in northern California, is said to have risen one hundred feet in perpendicular height, and the Willamette, at Oregon City, must have reached at least sixty feet. All these streams receive their water from the western side of the Sierra Nevada and Cascades, and from the Coast Mountains; the Klamath alone, even taking its source to the east. On the other hand, the floods of the great rivers Fraser's and the Columbia occur in the summer, and are occasioned not by rains, but by the melting of snows in the far distant range of the Rocky Mountains.

The body of water brought down by them, during the three or four months which elapse between their first rise in May and their subsidence in the fall, is enormous. At Fort Vancouver, where the river is a mile in width at its ordinary stage, the freshet of the Columbia reaches nineteen or twenty feet; overflowing the whole extent of flat country in addition, and the effect of the tides is lost in the resistless current which sweeps oceanward, so that the water, even on the bar of the Columbia, is drinkable, and vessels can fill at Astoria. Were the freshets of this river and the Willamette to occur together, the valley of the latter would be uninhabitable, for the flood of the Columbia, as it is, backs up the water of the Willamette so that vessels of considerable draught pass the rapids, and reach the foot of the falls at Oregon City.



COLUMBIA RIVER ABOVE THE DALLES.

Fall of the Rivers.

A sufficient number of observations have not been made to determine with nicety the fall of these rivers in different parts of their course. The height of Kootenay above the sea, where the 49th parallel first crosses it, is approximately 2,250 feet, and at the second or westerly crossing, 1,850 feet, being a descent of 400 feet in 126 miles, or an average of three feet two inches per mile. Of this distance the first thirty miles is over a gravelly bottom, with frequent ripples, and the last twenty-five or thirty miles, between Chelemta and the parallel, is deep and sluggish, with a bed of silt. The intermediate portion is rocky. The elevation of the river at the mouth was not ascertained, but that of the Columbia on the parallel, about twenty-five miles below, is 1,290 feet; the total distance being 120 miles, giving a fall of 560 feet, or four feet six inches to the mile. Of this last distance, however, about twenty miles is sluggish water, and thirty miles is occupied by the Flatbow Lake, the greater part of the fall being within a distance of forty-six miles between the lake and the entrance of the river into the Columbia. The height of the Flathead or Okinesahtl at the parallel is 3,700 feet; at the Sinyakwateen crossing, 300 miles below, it is 2,140 feet, giving an average descent of five feet to the mile, including the Flathead Lake, twenty-four miles in length, and a like distance between the eastern end of the Kalispelm Lake and the crossing. Thence to the Columbia at the parallel, about 100 miles, the fall is 840 feet, or eight feet four inches to the mile. The greater part of this last is over a rocky bed.

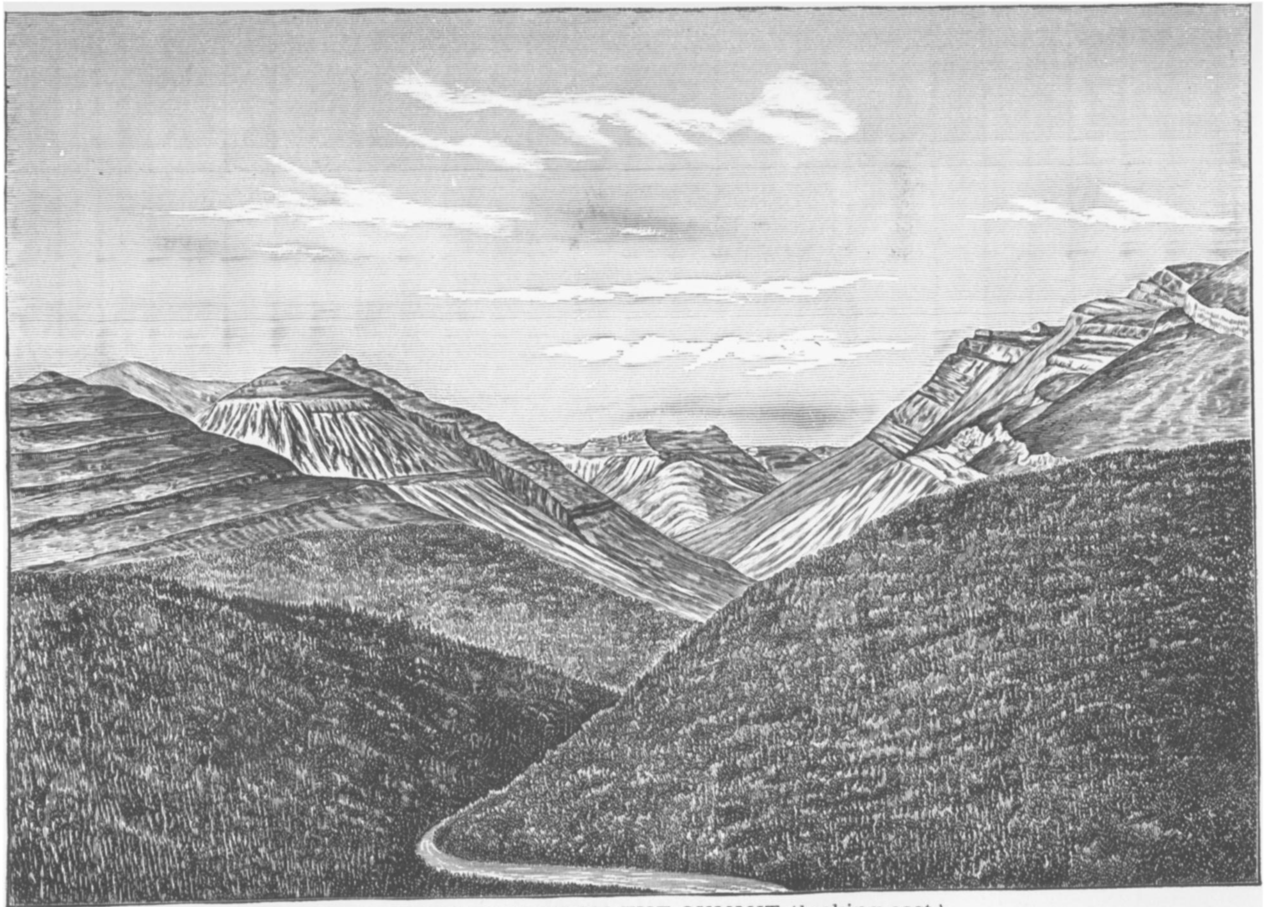
The elevation of the Columbia at Fort Colville is 1,179 feet, and the difference between that point and the parallel, thirty-three miles, is 111 feet, giving about three feet three inches to the mile. From Colville to the foot of the Cascades, at which latter point the influence of the tides is felt, is about 600 miles, giving a descent of nearly two feet to the mile, including fifty miles of sluggish water between the Dalles and the Cascades. The bed of the river, throughout, is of rock, and its course is broken by numerous rapids, besides two falls of some altitude. The fall of some of the lesser streams is much greater. That of the Similkameen, for instance, between the upper forks and the mouth, 121 miles, averages twenty-eight feet per mile; of the Nehoialpitkwu, from the crossing of the Schaiuks to its entrance into the Columbia, eighty-three miles, eighteen feet; and of the Spokane, from the Cœur d'Alene lake down, ninety-five miles, fourteen feet.

Such are the prominent physical traits of this extensive territory. The influence which they are destined to produce upon future population is one of the most interesting problems which the settlement of the west offers to us. They have exhibited themselves already upon a savage race, now rapidly vanishing, in making of one tribe fishermen, of another hunters, of a third diggers of roots and devourers of vermin; in making these sedentary and aquatic, and those nomads. How far will they affect the successors of the Indian? Not only is geography the result of geological action, but often civilization is also. Certainly the habits, the resources, and much of the personal character of mankind are affected by the face of the country which they inhabit, and nowhere is this result more sure than among the scattered valleys of the Bitter Root and Rocky Mountains.

MOUNTAIN AND RIVER SYSTEMS.

The mountain and river systems of this region need a somewhat more extended development than has been given above, and may form properly the subject of a separate notice.

From within a short distance of the Gulf of Georgia to the eastern base of the Rocky Mountains, on the parallel of forty-nine degrees, the whole country is mountainous. No plains of any extent spread out; no broad valleys



KOOTENAY PASS FROM THE SUMMIT (looking east.)

intervene to break the seemingly endless succession of chains, of ranges and of peaks. It may well be supposed, therefore, that where nature has worked on so colossal a scale, inferior parts of this grand whole are in themselves too vast for us to appreciate their comparative insignificance. While a great mountain range may have taken, as a whole, a distinct and well defined course, or while a system of ranges may possess certain absolute relations, such as that of parallelism, it may well be, as it here is, that extensive ridges and secondary divides run in almost every conceivable direction, perhaps radiating from some nucleus, forming groups around a center of upheaval, or starting as spurs from other ranges, and then again being broken and cut up in various directions by the irregularities of the original upheaving force, different resistance, or subsequently by the action of the elements, and thus all apparent order is lost. So, too, main ranges shift from one line to another, the fissure upon which they run being interrupted ; and again different ranges coalesce and become single or anastomose, in such manner that the general direction is hardly traceable. Here and there landmarks present themselves either in a row of peaks, rising on uniform lines, or a succession of passes indicating the position of a water-shed ; but this is far from being a common occurrence, and the attempt to follow any particular one, in a number of ranges, must often be based in part upon conjecture. It is to the hydrography of this country that we must look for the key to its mountains.

The number and size of the rivers and their remarkably similar character and direction, indicating the operation of uniform laws, at once attracts attention upon the map of North-western America.

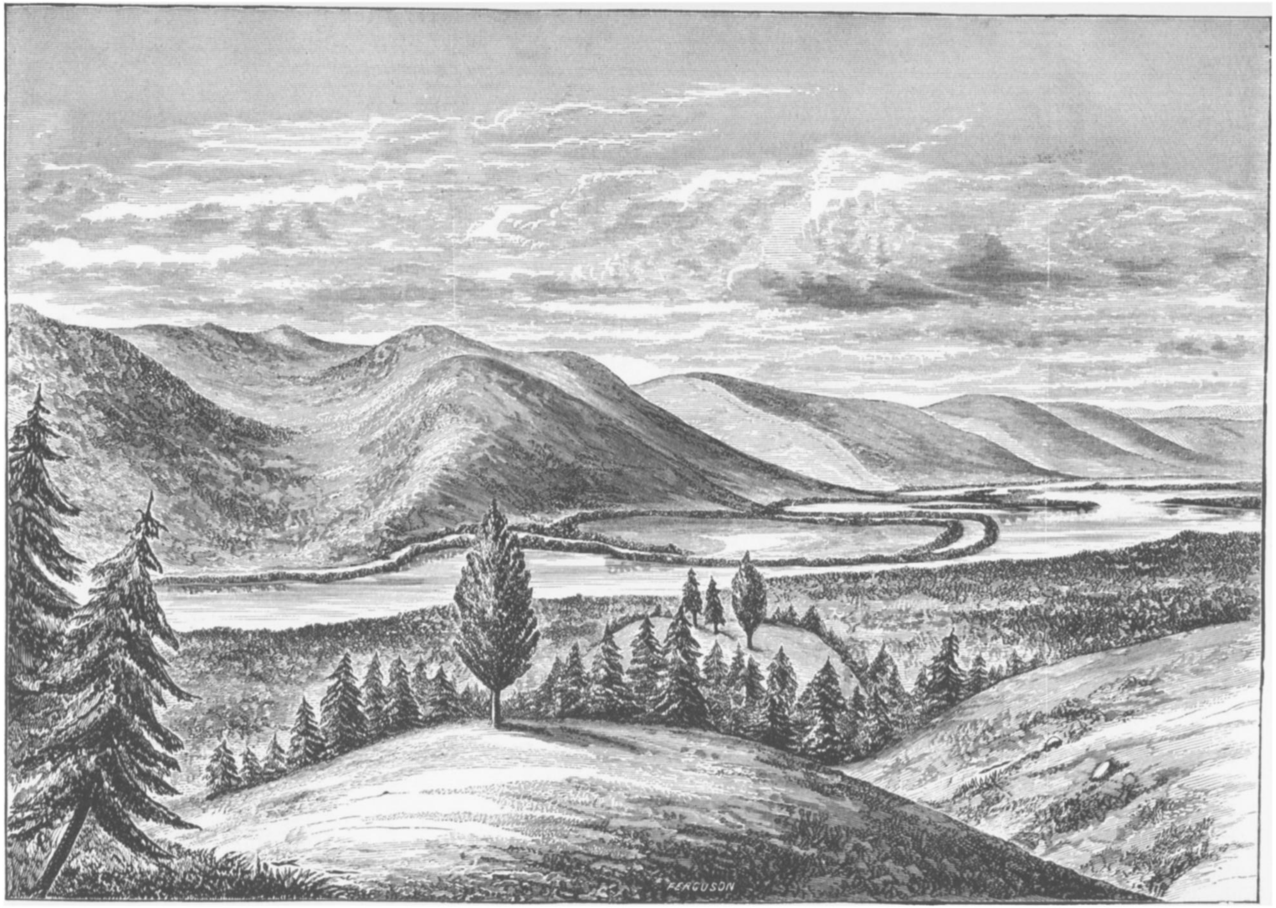
In giving my own views of the systems which intervene between the coast and the Rocky Mountains, it is proper to state that it is only approximate, and that a far greater accumulation of facts is requisite before they can be adopted as ultimate. Still I am not without confidence that the general results deduced are correct.

RIVERS.

The head waters of the Columbia, the Kootenay and the Flathead, or north branch of Clarke's fork, rise in the eastern Rocky Mountain ranges, overlapping one another, and the Columbia pursuing a directly opposite course to the others, its source being in Otter Lake, in latitude 50° 15′, whence it runs north-west to about 52° 5′, while the others run south-east and south.

At the junction of its most northerly branch, Canoe river, which rises in about 52° 40′ and interlocks with the head waters of Fraser river, the Columbia bends south, preserving this course with but inconsiderable deviations to the entrance of the Spokane in latitude 48°. It there turns west along the northern border of the Central Plateau to the mouth of the Okinakane, about a degree and a half of longitude, and again south, though less directly, till it reaches the forty-sixth degree of latitude, where it resumes a westerly direction to the mouth of the Willamette, breaking meanwhile through the Cascade range. On reaching, at this point, the depression which lies between the Cascade and Coast Mountains, it is deflected northward for nearly half a degree, and finally turns once more westward to the sea.

The Kootenay and Clarke's Fork, after escaping from the troughs of the eastern Rocky Mountain ranges, each apparently follow a general north-west course to their entrance into the Columbia, but really with considerable and very angular deflections, westward or northward, as they either successively break through ranges or run in their troughs (as will be seen in chapter VI). The valleys running north and south connect them even at these points. The Bitter Root or south branch of Clarke's Fork, heading a little below the forty-sixth parallel, runs due north to the entrance of the united Blackfoot and



KOOTENAY VALLEY FROM NEAR AKLEW CACHE.

Hellgate rivers, where it makes a deep westerly bend before joining with the Flathead. The course of the Okinakane is entirely parallel with that of the Columbia between the same latitudes, or nearly due south.

As regards the Snake river, though it partially agrees with the others, the geological and topographical features of the country through which it runs during a great part of its course, are entirely different, and a strict concordance could not be looked for. Thus from Fort Hall to where it strikes the foot of the Blue Mountains, near Fort Boiseé, it sweeps westward in a curve, through the great volcanic desert, a distance of four degrees of longitude; but on meeting with that range it turns north, and in conformity with it, finally breaking through westerly to join the Columbia. The Salmon river, its principal fork, also runs westerly for some four degrees, but most of its branches appear to run from south to north. The Des Chutes, which drains the eastern base of the Cascades, south of the Columbia, likewise follows that direction.

Even of the affluents of these various rivers, the greater part of those which have been accurately surveyed exhibit a north or south course, varied by sudden and shorter westerly or easterly deviations.

Fraser river presents these features even more distinctly. Heading in the Rocky Mountains in latitude 52° 40′, it runs north-west, conformably with the chain, to about 53° 35′, when it turns and runs south to Fort Hope, in latitude 49° 20′, and then west to the Gulf of Georgia. Its north fork, Stuart river, rises in latitude fifty-six, and trends a little east of south to the fifty-fourth parallel, when it turns east to its entrance into the main stream. Thompson river, the main branch of Fraser, taking its course near the fifty-third degree, is at first deflected to the south-east, then runs south to Fort Kamloops in 51° 40′, and thence west, and again southerly to its junction

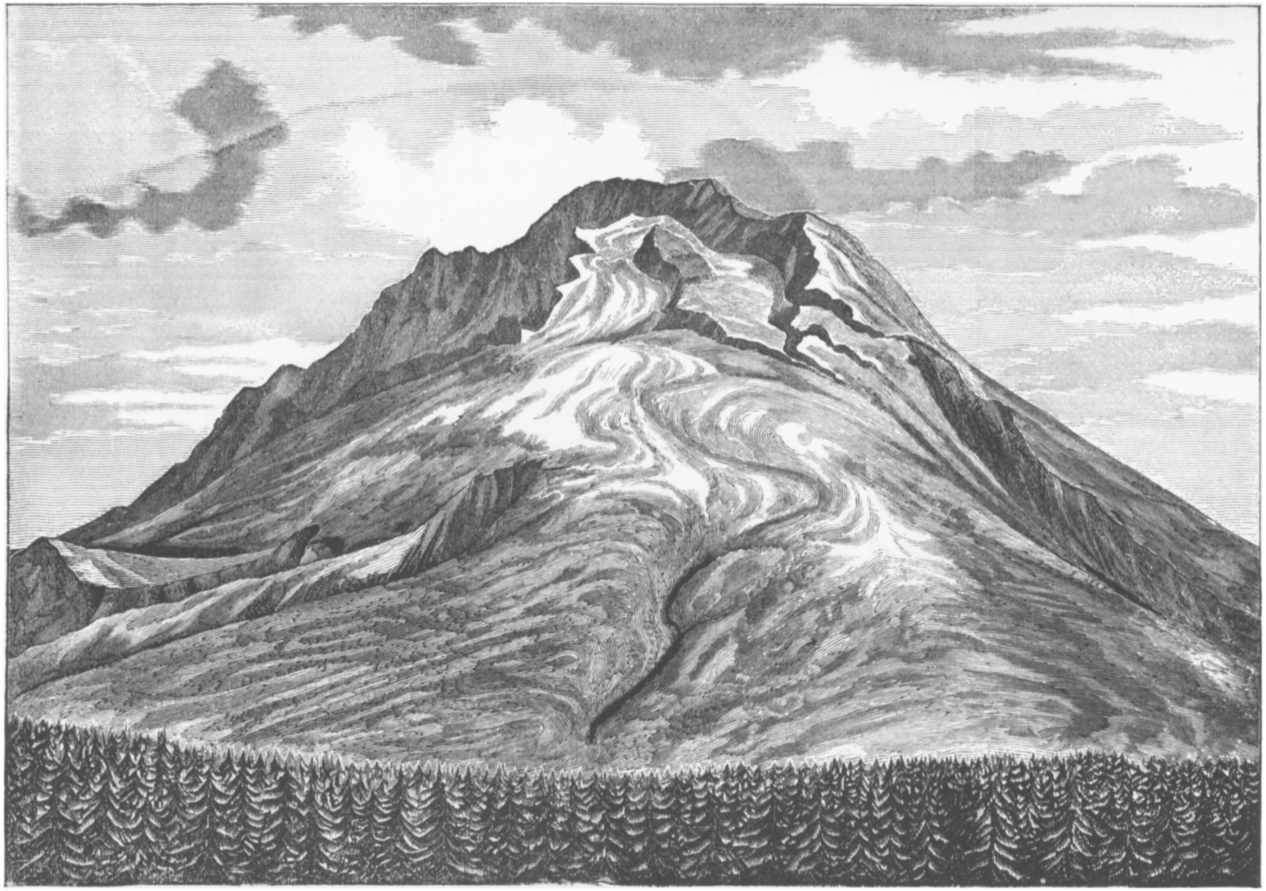
It thus appears that, excepting Salmon river, the Snake, and some others of the volcanic plateau, all the large streams of both the Columbia and Fraser rivers basins, and many even of the secondary ones, run in troughs between parallel ranges of mountains, those of the Rocky Mountain system having a conformable course, north-west or south-east; and those intermediate between that and the Cascades, north or south; and that, in seeking an outlet to the ocean, they transfer themselves westward, from one trough to another, by cutting through these ranges nearly at right angles. The only exceptions to this, I believe, occur where the ranges deviate to the westward, in which case the rivers generally cut through them diagonally.

Fraser river and the Columbia, both heading in the Rocky Mountains, in this manner cut, one after another, every range between them and the Pacific. Thompson river, in the same way divides the mountains from the western Columbia range to Fraser river; and their various branches shift from one trough to another before reaching an outlet.

The Skagit river alone cuts the main chain of the Cascades as the Klamath and Sacramento do the Sierra Nevada.

The Columbia, in its bend between the Spokane and the Okinakane, does not, it may be observed, cut through a range, but follows the line separating the volcanic rocks of the plateau from the granitic and metamorphic formation of the central range of the Cascades. The same is the fact with the Spokane river, which runs westward from the Cœur d'Alène lake into it. The observation, sometimes regarded as of universal application, that great deflections in the course of rivers indicate a change in the geology of the country, though true in this instance, cannot be regarded as of even ordinary application in respect to this system of waters.

A noticeable peculiarity in the hydrography of this region is, that the divide at the sources of many of the streams which head with one another, and run in opposite directions, is so low that a trifling erosion would con-



SUMMIT OF MOUNT HOOD, SHOWING THE CRATER, FROM THE EMIGRANT TRAIL.

nect them, and that numerous valleys, filled only with drift, modified, such as those between the Kootenay and Clarke's Fork, and between the latter and the Spokane, indicate that, at a former period, communications in continuance of their north and south courses, existed between rivers now diverted in other directions. It is to the peculiar direction of the mountain chains, as Mr. Dana has justly noticed, that these rivers owe their length and magnificent size. Thus the Columbia, including the Snake, drains a region extending from the forty-second to the fifty-second parallel of latitude, and Fraser river, from the forty-ninth to the fifty-sixth, the former having a length, exclusive of its branches or minor wanderings, of over twelve hundred English miles, and the latter of over seven hundred.

Of the principal branches of the Columbia, the Kootenay is over 400 miles long, the Flathead, taking the north fork, 450, and the Snake, 700 miles.

MOUNTAIN CHAINS.

As to the Coast range, it is unnecessary to add to what has been already observed. The western or true Cascades are in themselves so far a coast range that they follow its general trend, however distant it may now be.

Where the shore of the Pacific, from Cape Mendocino to the Straits of Fuca, follows generally the meridian, the Cascade Mountains conform to it, and where, in the latitude of the Straits (48° 30′), or, more correctly, at the southern end of the Gulf of Georgia, about latitude 49°, the coast takes up its north-westerly direction, a similar bend occurs in the Cascade chain. Thus, instead of ultimately coalescing with the Rocky Mountains, as otherwise they would have done, the Cascades, north of that point, run nearly parallel with them. There is, however, a broad mountain range, apparently belonging to the same system, which follows a different course.

I have taken the Okinikane river and lakes as the eastern limits of the Cascade Mountains, not only because they present the most direct prolongation of the lower Columbia, but because their valley is the lowest drain of all the streams between the Cascade and Rocky Mountains.

Starting with this assumption, it would seem that the Cascades, which to the southward are a single range, separate about the latitude of the Winatsha; and that, while the western or main branch continues on northward, crossing the Skagit, the other runs to the east of it, forming the divide between that river, on the one hand, and the Columbia and the Okinikane on the other.

Some question has been raised as to which of the ranges north of Fraser river constitutes the true continuation of the Cascades. Opposite to Fort Langley, one of them terminates in a bold butte, between the peaks of which lies a small glacier, and this appears upon the English maps as the main marine chain, Mt. Baker being delineated as in the same range to the south of the river. It will, however, elsewhere be seen that Mt. Baker is situated upon a spur, far to the west of the watershed; and it appears to me that the ranges west of Harrison lake, of which there seem to be three, are flanking ranges, which start from the river, and are not represented south of it, but that the one which divides Harrison lake from the upper Fraser, and is cut through by the river at Fort Yale, is the proper continuation of the Cascade chain. These flanking ranges, however, seem to equal the others in height, the peaks of all of them rising into the region of perpetual snow.

To return to the other branch of the Cascade range — that east of the Skagit. The watershed, though very irregular, lies much nearer to that river than to the Okinakane. In fact, the main Similkameen river and the west branch of the Pasayten, its principal fork, both head close to the Skagit itself. South of the forty-ninth parallel, this range is elevated and broken, having many peaks as high as the western Cascades; while north of it the ridges present a more uniform height. It has here much less the character of a range than that to the west, but is rather an assemblage of ridges extending over a degree and a half of longitude without traceable parallelism. Near the forty-ninth degree, these mountains again split into two by the valley of the Similkameen, and I have accordingly distinguished them on the profile as the Skagit of Similkameen ranges. Between Fraser and Thompson rivers, they are said to subside into a very elevated table-land.

East of the Okinakane is another range of mountains, which, though differing greatly from them in form and geological structure, rise to an equal average height with the Cascades, but which appear not to belong either to those on the Rocky Mountains. They line the Columbia river on the west, having a general north and south course to about the fifty-first parallel, where they also turn to west of north, forming the divide between the waters of the Columbia and those of Thompson river. This range was conjectured by Mr. Dana, and on apparently just grounds, to be the equivalent of the Blue Mountains of Oregon, and to bear the same relation to the Columbia that those do to the Snake river.

It is this one which I have denominated the Central range.

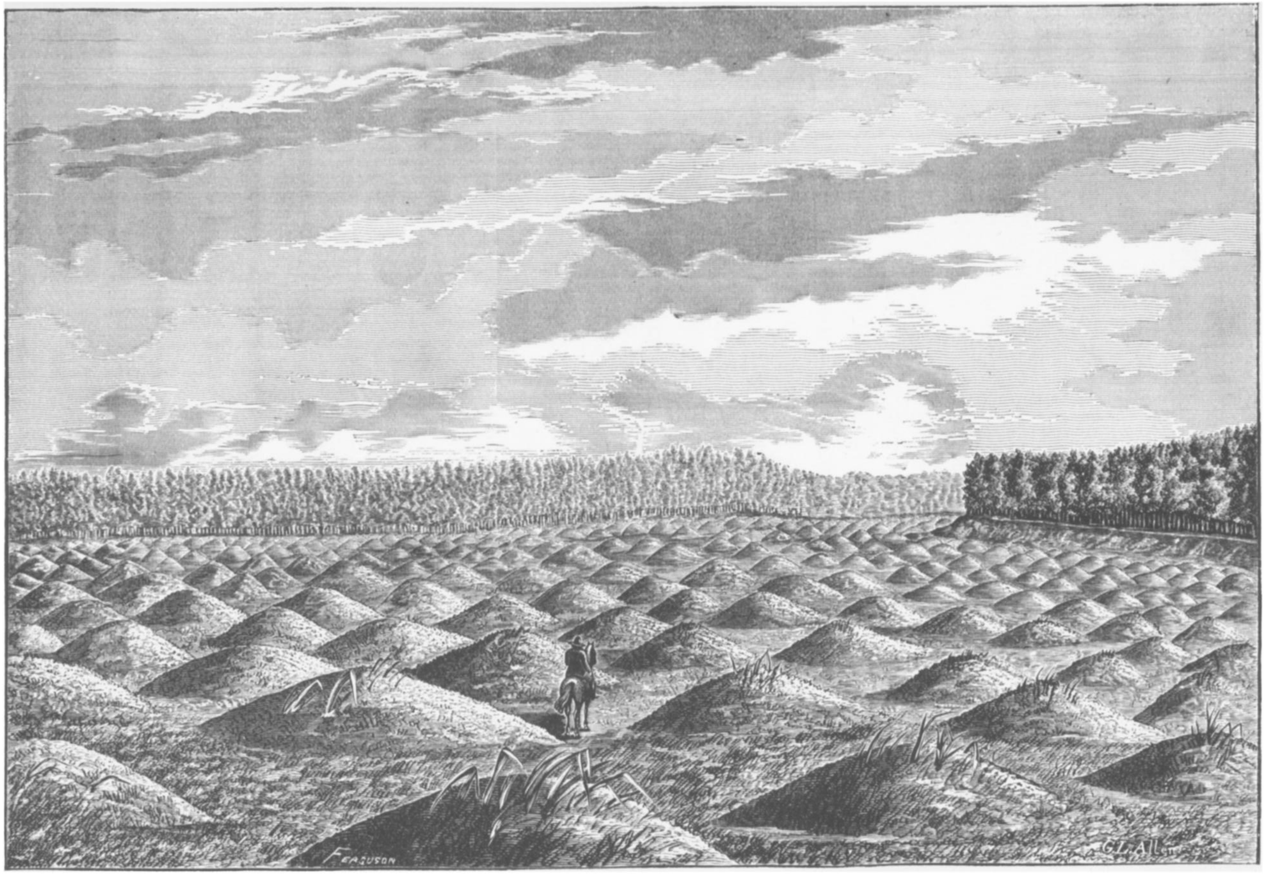
The direction of the ranges, between the Columbia river and the Rocky Mountains, is somewhat more obscure, owing, in part, to the deficiency hitherto of accurate topography. The explorations of the Commission will, however, elucidate that in the immediate neighborhood of the parallel.

The range generally represented as continuously bounding Clarke's Fork on the south-east, from the Columbia river to above Kalespelm lake, has no existence as such. On the contrary, the trend of the mountains appears to be here still north and south. The first range, I believe, which, as low down as the forty-ninth parallel, deviates from that direction, is that which lies in the great bend of the Kootenay. I have taken this to be a prolongation of the Bitter Root range, and, therefore, a part of the Rocky Mountain system. The eastern Rocky Mountains are, in this neighborhood, a series of parallel ridges, having a general north-westerly trend. Viewing the entire length of the chain, its watershed is remarkable for its sudden transfers from one line to another. The deviations which occur at the "parks" are well known; the north and south parks draining into the Mississippi, and the middle one into the Colorado. The basin drained by the upper waters of Clarke's Fork and the Kootenay has been already mentioned. Still more remarkable are those in British America, where the waters of the Unjigah or Peace river, and the Liard, both emptying through Mcakenzie river into the Arctic ocean, take their rise in the Peak Mountains, a range in some respects corresponding to the Wind River and Bitter Root Mountains, breaking through the eastern chain of the Rocky Mountains in their course.

I have been thus particular in attempting to follow these ranges, in order to illustrate what, from the best sources of information now existing, appears to be a general law; that all of them, from the coast to the western base of the Rocky Mountains, after pursuing, for a time, a general course from north to south, deflect to the west of north, and do not fall into or merge with the true Rocky Mountain system. The inference is, that the original skeleton of the continent was like its present form, fan-shaped.

Country Traversed by the Survey.

During the detention of the Commission at Camp Simiahmoo, reconnoissances were made of the country bordering upon the Sound, through the islands of the



THE MOUND PRAIRIES.

Gulf of Georgia, as far as Nanaimo; as also of the Skagit river to its canon; of the Nooksahk, and of Fraser river to Fort Yale. The route of the Survey eastward was by the Chiloweyuek, an affluent of Fraser river, over the Chuchchehum pass of the Cascade range to the upper waters of the Skagit; thence, crossing the divide between the waters of Puget Sound and those of the Columbia, along the southern branches of the Similkamen, to the junction of that river and the Okinikane, and by way of the Nehoialpitkwu to the Columbia.

From Fort Colville, a detour was made south to the Spokane, in order to avoid the mountains intervening between the Columbia and Clarke's Fork, and thence north, crossing the latter below the Kalispelm lake, and striking the Kootenay at Chelemta.

Following the right bank of the Kootenay down to the neighborhood of the parallel, the route next struck eastward to the Mooiye, one of its tributaries, which was pursued to its source in about latitude 49° 30′, and thence again to the Kootenay, following it down to the second crossing of the parallel. Thence the pass of the Akonoho, or Tobacco river, was taken over the range between the Kootenay and Akinesahtl, or Flathead, to the latter stream, and the Kishenehn pass across the divide of the Rocky Mountains to the waters of the Saskatchewan. Returning, the Kootenay was followed down to the Chelemta, crossing and recrossing, and the former route retraced to the Spokane ferry. Finally the Spokane plateau was traversed to Walla Walla, and the Columbia river descended to its mouth. Various side expeditions and reconnoissances were made from time to time by different members of the party, in addition.